

SYSTEM AND METHOD FOR SERVING PRE-GENERATED PRESENTATION VIEWS OF REQUESTED DATA

5 **Inventors:** Stefan Kiritzov, Benjamin Chang & Mark Scardina

BACKGROUND

 This invention relates to the fields of computer systems and databases. More particularly, a system and methods are provided for serving a pre-generated
10 presentation view of data in response to a request for the data.

 The distributed nature of database operating environments is typically manifested by a multi-tier architecture in which client systems from which users submit data requests and operations are separated from a data server hosting a database containing the data being manipulated. A middle-tier server (e.g., a web
15 server or application server) may be positioned between the client systems and the data server.

 Thus, in a typical three-tier architecture a data request is originated at a client through a browser or other suitable interface. The request is submitted to a middle-tier server in a particular format (e.g., HTTP or Hypertext Transport
20 Protocol). The HTTP request is received by a servlet (e.g., a server applet) or other module designed to parse the request, and an appropriate SQL (Structured Query Language) query is generated to locate the requested data in a database hosted by a data server. The middle-tier server then connects to the data server, the query is executed and a set of results is returned to the middle-tier server.

25 On the middle-tier server, the results may be transformed into a form suitable for returning to the client (e.g., a form recognizable and displayable by the client browser). For example, the data may be formatted according to XML

(eXtensible Markup Language) and a style sheet may be applied to generate a presentation view of the data that can be readily displayed by the browser.

This method of retrieving, formatting and presenting data to a user is very resource-intensive. More specifically, each time the middle-tier server satisfies a data request, a measurable amount of processor time and memory are required to complete the task. In particular, generating the presentation view of the data can be especially demanding of the middle-tier server's resources. For each additional user or request an additional increment of processor time and memory are required.

What is needed then is a system and a method for responding to a data request with suitable presentation views of the requested data, that scales well as additional requests are made. In particular, a desirable system and method would operate without requiring an unsupportable amount of resources during heavy periods of data requests.

SUMMARY

In one embodiment of the invention a system and methods are provided for retrieving and serving presentation views of data targeted by data requests received at a middle-tier server (e.g., a web server, an application server). In this embodiment a database stores data that may be requested by users (e.g., through client browsers) and also stores presentation views of the data formatted to be readily displayable by the client browsers. Thus, a presentation view may be generated by applying a style sheet to the data to format the data according to HTML (Hypertext Markup Language), SGML (Standard Generalized Markup Language), WML (Wireless Markup Language), etc.

The presentation views are generated on a time and/or event basis, as specified by applicable triggers. Thus, one trigger may initiate the generation of a

set of presentation views on a regular, time-sensitive, basis (e.g., every ten seconds, every hour). Another trigger may initiate the generation of a presentation view for a particular data item when that data item is altered, updated or replaced.

In one method of the invention a data request is received at a middle-tier server, which generates a suitable query to locate the requested data in a database. The middle-tier connects to a data server hosting the database (if the database is not resident on the middle-tier server) and the query is executed. Instead of receiving the queried data, which would then have to be formatted for service to the originator of the request, the data server provides a pre-generated presentation view of the data. The middle-tier server can then serve the presentation view, thereby greatly decreasing the level of middle-tier resources required to service the request.

An embodiment of the invention is customizable to individual client devices (e.g., smart telephone, wireless PDA (Personal Digital Assistant)). In this embodiment a first data request received at a middle-tier server from a client device may be handled in a pre-existing manner, in which the requested data is retrieved from a database, formatted on the middle-tier server and then served to the client. However, the capabilities and/or preferences of the client or user are noted and are then used to pre-generate presentation views of data in anticipation of another request from the same client. If another request is received, the customized presentation view can then be retrieved and quickly served rather than retrieving just the underlying data and having to generate the presentation view on the fly.

DESCRIPTION OF THE FIGURES

FIG. 1 is a block diagram depicting an implementation of an embodiment of the invention suitable for a three-tier computing environment.

FIG. 2 is a flowchart illustrating one method of responding to a data request with a pre-generated presentation view of the requested data, in accordance with an embodiment of the invention.

5

DETAILED DESCRIPTION

The following description is presented to enable any person skilled in the art to make and use the invention, and is provided in the context of particular applications of the invention and their requirements. Various modifications to the disclosed embodiments will be readily apparent to those skilled in the art and the general principles defined herein may be applied to other embodiments and applications without departing from the spirit and scope of the present invention. Thus, the present invention is not intended to be limited to the embodiments shown, but is to be accorded the widest scope consistent with the principles and features disclosed herein.

15 The program environment in which a present embodiment of the invention is executed illustratively incorporates a general-purpose computer or a special purpose device such as a hand-held computer, personal digital assistant, wireless telephone, etc. Details of such devices (e.g., processor, memory, data storage, display) are omitted for the sake of clarity.

20 It should also be understood that the techniques of the present invention might be implemented using a variety of technologies. For example, the methods described herein may be implemented in software executing on a computer system, or implemented in hardware utilizing either a combination of microprocessors or other specially designed application specific integrated
25 circuits, programmable logic devices, or various combinations thereof. In particular, the methods described herein may be implemented by a series of computer-executable instructions residing on a storage medium such as a carrier

wave, disk drive, or computer-readable medium. Exemplary forms of carrier waves may take the form of electrical, electromagnetic or optical signals conveying digital data streams along a local network or a publicly accessible network such as the Internet.

5 In one embodiment of the invention a system and methods are provided for serving presentation views of requested data. Data may, for example, be requested by a browser operating on a client device such as a personal computer, hand-held computer, smart telephone or other wireless device. A data request is received at a middle-tier server, which may be a web server, application server or
10 other computer system configured for receiving and responding to data requests. A request is analyzed and a suitable data query is generated to locate the requested data in a database, table or other data store. The data may be stored on a separate computer system (e.g., a data server). Instead of returning just the requested data, however, the data server retrieves and returns to the middle-tier server a pre-
15 generated presentation view of the data. The presentation view may, for example, have been generated by applying a style sheet to the requested data (or an XML (eXtensible Markup Language) version of the data). The middle-tier server receives the presentation view and serves it to the client.

 In this embodiment, the generation of a presentation view for a data item
20 or a set of data is controlled or determined by a trigger. A trigger may initiate such generation after a period of time passes (e.g., from the last generation of a presentation view for the data), in response to the alteration or replacement of the data, on a random basis, etc.

 Advantageously, by retrieving and serving pre-generated presentation
25 views, data is provided to a requesting device faster than it would be if the middle-tier server (or other computer system) had to retrieve the requested data and generate a presentation view after a request is received. The amount of

system (e.g., middle-tier server) resources required to service numerous data requests is thereby greatly decreased.

The types of presentation views, such as HTML (Hypertext Markup Language), WML (Wireless Markup Language), SGML (Standard Generalized Markup Language) and the data for which presentation views are pre-generated can be dynamic. In other words, for a given data item or data set, any number of presentation views may be pre-generated, and the number and types of views may change over time as requests for the data are received from different devices or different types of devices having different display capabilities or requirements. For example, only HTML pages may be pre-generated for one data set until a device that requires WML views submits a request for the data. Then WML views may also be pre-generated. Similarly, a presentation view may be pre-generated for only a subset of all available data. Thus, for a table of Employee data in an organization, presentation views may only be pre-generated for commonly requested records or objects, for records that have been recently requested, etc.

Illustratively, a presentation view may be stored within a database that already stores the original data or may be stored separately. For example, in an Oracle Server® database, a presentation view may be stored as a CLOB (character large object) file within the same database.

FIG. 1 depicts an illustrative three-tier computing environment in which an embodiment of the invention may be implemented. The illustrated environment comprises client device 100 (e.g., a wireless telephone or PDA (Personal Digital Assistant), portable computer), middle-tier server 110 (e.g., a web server) and data server 120.

As depicted in FIG. 1, client 100 operates browser (or other module, such as a Java® application) 102 for viewing data. The browser may be capable of

displaying data in various formats (e.g., HTML, WML) or may require a specific format. In this embodiment of the invention, data requests are initiated from client 100, by a user, through browser 102.

5 Middle-tier server 110 operates servlet (i.e., server applet) 112 for receiving and responding to data requests from client devices. Servlet 112 may be configured specifically for cooperation with a particular set of clients and/or data, or may be capable of handling and servicing requests from various devices for data stored in multiple locations.

10 Data server 120 maintains database 122, which stores data requested by client 100. Presentation view 126 is pre-generated for a subset of the data of database 122, on a schedule determined by trigger 124. Although presentation view 126 is depicted separately from database 122 in FIG. 1, in alternative embodiments of the invention a presentation view may be stored within the database or on some other computer system (e.g., middle-tier server 110). Trigger
15 124 may comprise a stored procedure, a Java applet or other utility or application associated with (or included in) database 122.

In the embodiment of FIG. 1, data server 120 also includes the necessary utilities or applications (not separately shown in FIG. 1) for generating presentation view 126 from data within database 122. Illustratively, database 122
20 may be an Oracle Server® database, in which case this functionality may be included within the database. Specifically, Oracle Server® version 8i is Java-capable, in that it can manipulate Java objects and operate Java applets (e.g., to apply XSL (eXtensible Stylesheet Language) style sheets). The database engine may thus incorporate an XML SQL utility to place data into the XML format and
25 apply an XSL style sheet.

In one specific implementation of the embodiment of FIG. 1, database 122 is an Oracle Server® database storing one or more tables of data required by

devices such as client 100. On a schedule determined by trigger 124, presentation view 126 is pre-generated from a subset of the data stored in database 122 (e.g. all or a portion of a particular table). In this implementation a presentation view may be generated when a predetermined period of time (e.g., sixty seconds, ten
5 minutes, one hour) passes after the last generation of a presentation view. Thus, presentation view 126 may be regularly replaced with a new or updated presentation view. Alternatively, a new presentation view may be generated at a random time (e.g., within a specified range of times) or when the data for which the presentation view is being pre-generated is altered or replaced. The
10 presentation view in this implementation comprises an HTML view of the data, which may be created by first applying XML tags to the data and then applying a style sheet to convert the XML data to HTML.

In the presently discussed implementation of the embodiment of the invention depicted in FIG. 1, sometime after presentation view 126 is generated,
15 browser 102 of client 100 originates an HTTP (Hypertext Transport Protocol) data request or operation and forwards it to middle-tier server 110. Servlet 112 receives and recognizes the request, parses it and creates an appropriate SQL (Structured Query Language) query to submit to Oracle Server® database 122. The servlet connects to data server 120 and the query is executed and the
20 responsive data is identified. This data includes or matches the data for which presentation view 126 was generated. Thus, presentation view 126 is retrieved and returned to middle-tier server 110. Middle-tier server 110 then serves the presentation view to client 100.

In the embodiment of FIG. 1, presentation view 126 may be served in
25 response to a data request even if the presentation view was generated from a stale or obsolete version of the data. For example, if trigger 124 operates on a time basis, the data may be changed between the time a first presentation view of the

data is generated and the time a second view is generated. The stale presentation view may still be served in this situation because it is known that an updated view will soon be generated and it has been determined that it is more efficient to serve a stale view than to try and meet each request with a fresh view, which would
5 require the expenditure of resources that are otherwise saved. If, for example, data changes are very frequent (e.g., every second), it may be inefficient and unwarranted to generate a new view for each data change; in this case a time-based trigger is appropriate. Alternatively, however, a fresh presentation view could be generated under a configurable set of circumstances – it is a relatively
10 long period of time until the trigger initiates generation of a new view, the data rarely changes (in which case it may be more important to serve an updated view), etc.

A change-based trigger may be appropriate for relatively static data sets. For example, for a database of news stories, a new (or updated) presentation view
15 may be pre-generated each time a new (or replacement) story is added to the database.

Either a time-based or a change-based trigger may be appropriate, for example, with a database of stock quotes. In this example, a stock quote may change on a very frequent, somewhat frequent, relatively infrequent or other basis.
20 Possibly depending on the individual quote, a presentation view may be generated every ten seconds, every minute, for each change, etc. In this example, the use of triggers to pre-generate presentation views of the data allows the system to quickly serve a relatively small set of data (e.g., there are a limited number of publicly traded stocks) to a potentially vast number of requests or requestors
25 without expending a large amount of system resources.

An embodiment of the invention may be customized or tailored for a particular device or set of devices (e.g., a type of wireless telephone having

specific capabilities or requirements). In this embodiment, a presentation view suitable for display on or use by a device may not be available when a first request is received from the device. Thus, this first request may require a presentation view to be generated (e.g., on a middle-tier server) after the requested data is
5 located and retrieved in response to the request. However, in anticipation of a future request from the same or a similar device, the requirements of the device (or preferences of its user) may be noted and presentation views may then be pre-generated. The type of device, or its requirements or preferences may, for example, be included or identified in the header of a first HTTP request.

10 For a new device or a device not before encountered, a style sheet may not be available when a first request is received from the device. Then, when the first request is serviced an appropriate style sheet may be created or retrieved, and used from then on to pre-generate presentation views.

FIG. 2 is a flowchart demonstrating one method of using triggers to pre-
15 generate a presentation view of a data item for serving in response to a request for the data item, in accordance with one embodiment of the invention. Although the illustrated method is described in use in a three-tier environment, the method may be readily adapted for use in a different architecture (e.g., a client-server or two-tier environment). In a two-tier environment, for example, the composition and
20 functions of the data server described below may be included in the middle-tier server.

In state 200, a data item is stored on a data server. The data item may, for example, be an entry (e.g., record, object) within a database table.

In state 202 it is determined whether the condition(s) of a pre-configured
25 trigger associated with the data item has/have expired or been met. Thus, for a time-based trigger, it is determined whether the required period of time has expired since a previous presentation view of the data item was generated. For a

change-based trigger, it is determined whether the data item was replaced, updated or otherwise altered since a previous presentation view of the data item was generated. Other types of triggers may depend on other parameters, operations or occurrences. For example, a trigger for one data item may be initiated by the operation of a trigger for another data item. Another trigger may be configured to fire when the data server is initialized, re-initialized or shut down.

One trigger may be associated with multiple data items, databases, tables or other sets of data and may be configured to operate differently for different sets of data (e.g., to generate presentation views for different sets of data upon different passages of time or events).

If the condition(s) of the trigger are met for the data item in state 202, the illustrated method proceeds to state 204. Otherwise, until trigger conditions are met, data operations (e.g., updates, replacements, presentations) are performed or time passes. Eventually, however, a trigger condition is satisfied (e.g., event or time passage) and the illustrated method continues to state 204.

In state 204 a presentation view of the data item is generated according to a profile or set of parameters associated with the data item. A profile or parameter may, for example, indicate the format of the presentation view (e.g., HTML, WML, plain text), indicate that multiple presentation views (e.g., in different formats) are to be generated, indicate where the presentation view is to be stored, etc. The presentation view may, for example, be stored as a file within the same database as the data item. Alternatively, the presentation view may be stored separate from the database, in which case a file name or other identifier of the view may be stored in the database to facilitate its retrieval.

Generation of the presentation view may comprise the execution of a stored procedure or a Java (or other) application built into the database. As one alternative, generation of the presentation view may involve the invocation of a

utility or application external to the database. In short, the utilities, style sheets and other modules needed to compute or generate the presentation view may be part of the database that stores the data item or may be separate. Likewise, the trigger may operate as part of the database or external to it.

5 The presentation view is then stored, in state 206, possibly within the database.

 In state 208, which occurs some time after the presentation view is generated, a request for the data item (or operation involving the data item) is received at a middle-tier server that has access to the data server. For example, in
10 a network environment including the Internet or an intranet, a middle-tier server may act as a web server and receive data requests or operations from one or more client devices. The request may identify the type of device that sent the request, its capabilities or requirements, preferences for receiving the data (e.g., a preferred format), etc.

15 In state 210 the middle-tier initiates a search or retrieval of the requested data or the data involved in the operation. Illustratively, this may comprise the submission of a query to the database or data server.

 In state 212, the data item is identified and the associated presentation view is retrieved. Where multiple views of the same data item (e.g., different
20 formats, sizes, layouts) were generated, one or more parameters of the request or operation may be used to determine which view to retrieve.

 In state 214 a presentation view suitable for the requesting device is returned to the middle-tier server and passed to the device. Alternatively, the presentation view may be forwarded directly from the data server to the device.

25 FIG. 2 and the preceding description illustrate just one method for using a trigger to pre-generate presentation views of data for responding to data requests.

In other embodiments of the invention alternative methods derivable from the illustrated method may be implemented.

5 The foregoing descriptions of embodiments of the invention have been presented for purposes of illustration and description only. They are not intended to be exhaustive or to limit the invention to the forms disclosed. Many modifications and variations will be apparent to practitioners skilled in the art. Accordingly, the above disclosure is not intended to limit the invention; the scope of the invention is defined by the appended claims.

10

11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100
101
102
103
104
105
106
107
108
109
110
111
112
113
114
115
116
117
118
119
120
121
122
123
124
125
126
127
128
129
130
131
132
133
134
135
136
137
138
139
140
141
142
143
144
145
146
147
148
149
150
151
152
153
154
155
156
157
158
159
160
161
162
163
164
165
166
167
168
169
170
171
172
173
174
175
176
177
178
179
180
181
182
183
184
185
186
187
188
189
190
191
192
193
194
195
196
197
198
199
200
201
202
203
204
205
206
207
208
209
210
211
212
213
214
215
216
217
218
219
220
221
222
223
224
225
226
227
228
229
230
231
232
233
234
235
236
237
238
239
240
241
242
243
244
245
246
247
248
249
250
251
252
253
254
255
256
257
258
259
260
261
262
263
264
265
266
267
268
269
270
271
272
273
274
275
276
277
278
279
280
281
282
283
284
285
286
287
288
289
290
291
292
293
294
295
296
297
298
299
300
301
302
303
304
305
306
307
308
309
310
311
312
313
314
315
316
317
318
319
320
321
322
323
324
325
326
327
328
329
330
331
332
333
334
335
336
337
338
339
340
341
342
343
344
345
346
347
348
349
350
351
352
353
354
355
356
357
358
359
360
361
362
363
364
365
366
367
368
369
370
371
372
373
374
375
376
377
378
379
380
381
382
383
384
385
386
387
388
389
390
391
392
393
394
395
396
397
398
399
400
401
402
403
404
405
406
407
408
409
410
411
412
413
414
415
416
417
418
419
420
421
422
423
424
425
426
427
428
429
430
431
432
433
434
435
436
437
438
439
440
441
442
443
444
445
446
447
448
449
450
451
452
453
454
455
456
457
458
459
460
461
462
463
464
465
466
467
468
469
470
471
472
473
474
475
476
477
478
479
480
481
482
483
484
485
486
487
488
489
490
491
492
493
494
495
496
497
498
499
500
501
502
503
504
505
506
507
508
509
510
511
512
513
514
515
516
517
518
519
520
521
522
523
524
525
526
527
528
529
530
531
532
533
534
535
536
537
538
539
540
541
542
543
544
545
546
547
548
549
550
551
552
553
554
555
556
557
558
559
560
561
562
563
564
565
566
567
568
569
570
571
572
573
574
575
576
577
578
579
580
581
582
583
584
585
586
587
588
589
590
591
592
593
594
595
596
597
598
599
600
601
602
603
604
605
606
607
608
609
610
611
612
613
614
615
616
617
618
619
620
621
622
623
624
625
626
627
628
629
630
631
632
633
634
635
636
637
638
639
640
641
642
643
644
645
646
647
648
649
650
651
652
653
654
655
656
657
658
659
660
661
662
663
664
665
666
667
668
669
670
671
672
673
674
675
676
677
678
679
680
681
682
683
684
685
686
687
688
689
690
691
692
693
694
695
696
697
698
699
700
701
702
703
704
705
706
707
708
709
710
711
712
713
714
715
716
717
718
719
720
721
722
723
724
725
726
727
728
729
730
731
732
733
734
735
736
737
738
739
740
741
742
743
744
745
746
747
748
749
750
751
752
753
754
755
756
757
758
759
760
761
762
763
764
765
766
767
768
769
770
771
772
773
774
775
776
777
778
779
780
781
782
783
784
785
786
787
788
789
790
791
792
793
794
795
796
797
798
799
800
801
802
803
804
805
806
807
808
809
810
811
812
813
814
815
816
817
818
819
820
821
822
823
824
825
826
827
828
829
830
831
832
833
834
835
836
837
838
839
840
841
842
843
844
845
846
847
848
849
850
851
852
853
854
855
856
857
858
859
860
861
862
863
864
865
866
867
868
869
870
871
872
873
874
875
876
877
878
879
880
881
882
883
884
885
886
887
888
889
890
891
892
893
894
895
896
897
898
899
900
901
902
903
904
905
906
907
908
909
910
911
912
913
914
915
916
917
918
919
920
921
922
923
924
925
926
927
928
929
930
931
932
933
934
935
936
937
938
939
940
941
942
943
944
945
946
947
948
949
950
951
952
953
954
955
956
957
958
959
960
961
962
963
964
965
966
967
968
969
970
971
972
973
974
975
976
977
978
979
980
981
982
983
984
985
986
987
988
989
990
991
992
993
994
995
996
997
998
999
1000
1001
1002
1003
1004
1005
1006
1007
1008
1009
1010
1011
1012
1013
1014
1015
1016
1017
1018
1019
1020
1021
1022
1023
1024
1025
1026
1027
1028
1029
1030
1031
1032
1033
1034
1035
1036
1037
1038
1039
1040
1041
1042
1043
1044
1045
1046
1047
1048
1049
1050
1051
1052
1053
1054
1055
1056
1057
1058
1059
1060
1061
1062
1063
1064
1065
1066
1067
1068
1069
1070
1071
1072
1073
1074
1075
1076
1077
1078
1079
1080
1081
1082
1083
1084
1085
1086
1087
1088
1089
1090
1091
1092
1093
1094
1095
1096
1097
1098
1099
1100
1101
1102
1103
1104
1105
1106
1107
1108
1109
1110
1111
1112
1113
1114
1115
1116
1117
1118
1119
1120
1121
1122
1123
1124
1125
1126
1127
1128
1129
1130
1131
1132
1133
1134
1135
1136
1137
1138
1139
1140
1141
1142
1143
1144
1145
1146
1147
1148
1149
1150
1151
1152
1153
1154
1155
1156
1157
1158
1159
1160
1161
1162
1163
1164
1165
1166
1167
1168
1169
1170
1171
1172
1173
1174
1175
1176
1177
1178
1179
1180
1181
1182
1183
1184
1185
1186
1187
1188
1189
1190
1191
1192
1193
1194
1195
1196
1197
1198
1199
1200
1201
1202
1203
1204
1205
1206
1207
1208
1209
1210
1211
1212
1213
1214
1215
1216
1217
1218
1219
1220
1221
1222
1223
1224
1225
1226
1227
1228
1229
1230
1231
1232
1233
1234
1235
1236
1237
1238
1239
1240
1241
1242
1243
1244
1245
1246
1247
1248
1249
1250
1251
1252
1253
1254
1255
1256
1257
1258
1259
1260
1261
1262
1263
1264
1265
1266
1267
1268
1269
1270
1271
1272
1273
1274
1275
1276
1277
1278
1279
1280
1281
1282
1283
1284
1285
1286
1287
1288
1289
1290
1291
1292
1293
1294
1295
1296
1297
1298
1299
1300
1301
1302
1303
1304
1305
1306
1307
1308
1309
1310
1311
1312
1313
1314
1315
1316
1317
1318
1319
1320
1321
1322
1323
1324
1325
1326
1327
1328
1329
1330
1331
1332
1333
1334
1335
1336
1337
1338
1339
1340
1341
1342
1343
1344
1345
1346
1347
1348
1349
1350
1351
1352
1353
1354
1355
1356
1357
1358
1359
1360
1361
1362
1363
1364
1365
1366
1367
1368
1369
1370
1371
1372
1373
1374
1375
1376
1377
1378
1379
1380
1381
1382
1383
1384
1385
1386
1387
1388
1389
1390
1391
1392
1393
1394
1395
1396
1397
1398
1399
1400
1401
1402
1403
1404
1405
1406
1407
1408
1409
1410
1411
1412
1413
1414
1415
1416
1417
1418
1419
1420
1421
1422
1423
1424
1425
1426
1427
1428
1429
1430
1431
1432
1433
1434
1435
1436
1437
1438
1439
1440
1441
1442
1443
1444
1445
1446
1447
1448
1449
1450
1451
1452
1453
1454
1455
1456
1457
1458
1459
1460
1461
1462
1463
1464
1465
1466
1467
1468
1469
1470
1471
1472
1473
1474
1475
1476
1477
1478
1479
1480
1481
1482
1483
1484
1485
1486
1487
1488
1489
1490
1491
1492
1493
1494
1495
1496
1497
1498
1499
1500
1501
1502
1503
1504
1505
1506
1507
1508
1509
1510
1511
1512
1513
1514
1515
1516
1517
1518
1519
1520
1521
1522
1523
1524
1525
1526
1527
1528
1529
1530
1531
1532
1533
1534
1535
1536
1537
1538
1539
1540
1541
1542
1543
1544
1545
1546
1547
1548
1549
1550
1551
1552
1553
1554
1555
1556
1557
1558
1559
1560
1561
1562
1563
1564
1565
1566
1567
1568
1569
1570
1571
1572
1573
1574
1575
1576
1577
1578
1579
1580
1581
1582
1583
1584
1585
1586
1587
1588
1589
1590
1591
1592
1593
1594
1595
1596
1597
1598
1599
1600
1601
1602
1603
1604
1605
1606
1607
1608
1609
1610
1611
1612
1613
1614
1615
1616
1617
1618
1619
1620
1621
1622
1623
1624
1625
1626
1627
1628
1629
1630
1631
1632
1633
1634
1635
1636
1637
1638
1639
1640
1641
1642
1643
1644
1645
1646
1647
1648
1649
1650
1651
1652
1653
1654
1655
1656
1657
1658
1659
1660
1661
1662
1663
1664
1665
1666
1667
1668
1669
1670
1671
1672
1673
1674
1675
1676
1677
1678
1679
1680
1681
1682
1683
1684
1685
1686
1687
1688
1689
1690
1691
1692
1693
1694
1695
1696
1697
1698
1699
1700
1701
1702
1703
1704
1705
1706
1707
1708
1709
1710
1711
1712
1713
1714
1715
1716
1717
1718
1719
1720
1721
1722
1723
1724
1725
1726
1727
1728
1729
1730
1731
1732
1733
1734
1735
1736
1737
1738
1739
1740
1741
1742
1743
1744
1745
1746
1747
1748
1749
1750
1751
1752
1753
1754
1755
1756
1757
1758
1759
1760
1761
1762
1763
1764
1765
1766
1767
1768
1769
1770
1771
1772
1773
1774
1775
1776
1777
1778
1779
1780
1781
1782
1783
1784
1785
1786
1787
1788
1789
1790
1791
1792
1793
1794
1795
1796
1797
1798
1799
1800
1801
1802
1803
1804
1805
1806
1807
1808
1809
1810
1811
1812
1813
1814
1815
1816
1817
1818
1819
1820
1821
1822
1823
1824
1825
1826
1827
1828
1829
1830
1831
1832
1833
1834
1835
1836
1837
1838
1839
1840
1841
1842
1843
1844
1845
1846
1847
1848
1849
1850
1851
1852
1853
1854
1855
1856
1857
1858
1859
1860
1861
1862
1863
1864
1865
1866
1867
1868
1869
1870
1871
1872
1873
1874
1875
1876
1877
1878
1879
1880
1881
1882
1883
1884
1885
1886
1887
1888
1889
1890
1891
1892
1893
1894
1895
1896
1897
1898
1899
1900
1901
1902
1903
1904
1905
1906
1907
1908
1909
1910
1911
1912
1913
1914
1915
1916
1917
1918
1919
1920
1921
1922
1923
1924
1925
1926
1927
1928
1929
1930
1931
1932
1933
1934
1935
1936
1937
1938
1939
1940
1941
1942
1943
1944
1945
1946
1947
1948
1949
1950
1951
1952
1953
1954
1955
1956
1957
1958
1959
1960
1961
1962
1963
1964
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
2034
2035
2036
2037
2038
2039
2040
2041
2042
2043
2044
2045
2046
2047
2048
2049
2050
2051
2052
2053
2054
2055
2056
2057
2058
2059
2060
2061
2062
2063
2064
2065
2066
2067
2068
2069
2070
2071
2072
2073
2074
2075
2076
2077
2078
2079
2080
2081
2082
2083
2084
2085
2086
2087
2088
2089
2090
2091
2092
2093
2094
2095
2096
2097
2098
2099
2100
2101
2102
2103
2104
2105
2106
2107
2108
2109
2110
2111
2112
2113
2114
2115
2116
2117
2118
2119
2120
2121
2122
2123
2124
2125
2126
2127
2128
2129
2130
2131
2132
2133
2134
2135
2136
2137
2138
2139
2140
2141
2142
2143
2144
2145
2146
2147
2148
2149
2150
2151
2152
2153
2154
2155
2156
2157
2158
2159
2160
2161
2162
2163
2164
2165
2166
2167
2168
2169
2170
2171
2172
2173
2174
2175
2176
2177
2178
2179
2180
2181
2182
2183
2184
2185
2186
2187
2188
2189
2190
2191
2192
2193
2194
2195
2196
2197
2198
2199
2200
2201
2202
2203
2204
2205
2206
2207
2208
2209
2210
2211
2212
2213
2214
2215
2216
2217
22